JOTTINGS FROM THE BIOLOGICAL LABORATORY OF SYDNEY UNIVERSITY.

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No. 18.—Note on Certain Points in the Arrangement and Structure of the Tentaculiferous Lobes in *Nautilus pompilius*.

(Plate xlviii.)

In writing a short account of the structure of Nautilus for a general work I have had occasion to examine a considerable number of specimens, and in doing so have noticed one or two points to which attention has, I think, not hitherto been directed. The most important of these, with which alone the present communication deals, has to do with the tentaculiferous lobes of the foot, and their sexual modifications.

No fewer than three papers published or read recently deal with sexual differences in Nautilus. Two of these, one by Willey,* the other by Vayssière,† refer only to sexual differences in the shell; the third, by J. Graham Kerr,‡ is referred to below.

The tentacles of Nautilus are arranged in two series—an outer, and an inner. With the outer series we are not at present concerned. The inner series exhibit a marked sexual difference in their arrangement. In the female this inner series consists of two symmetrical lateral lobes, each bearing twelve tentacles, and of a median (posterior) portion. In the male the two lateral lobes of the inner series are unsymmetrically developed, four of the tentacles of one side, usually the left, being modified to form the structure known as the spadix.

The spadix was first described by Van der Hoeven.§ He calls it "a great conoid body, the length of which was nearly $2\frac{1}{2}$

* Natural Science, June, 1895.

† Comptes Rendus, 24th June, 1895.

‡ Zoological Society of London, Abstract of Proceedings, June 18, 1895.

§ Trans. Zool. Soc., Vol. iv., p 27. The earlier Dutch papers are not accessible to me.

inches; this part was laterally compressed; at its basis its measure from the dorsal to the ventral side was found to be 1 inch, 10 lines; from the right to the left side only 1 inch." He adds "This part was proved to me by dissecting it to be formed by the union of four unusually developed tentacular slips, one of which was shorter and more free, the three other chiefly composing the singular body."

From the dimensions here given and the figures accompanying the paper it would appear that Van der Hoeven had under observation a completely or nearly completely developed specimen. Such mature specimens are comparatively rare; and all the male Nautili that have been made the subjects of other published descriptions appear to have been immature, so that some important and interesting points in the structure of the fully-developed spadix have been overlooked.

In the larger of the two mature male specimens I have had the opportunity of examining (in which the greatest diameter of the shell is $6\frac{1}{2}$ inches) the total length of the organ is $3\frac{1}{4}$ inches, the greatest breadth about $1\frac{1}{3}$ inch, and the thickness a little less than an inch. The four tentacles composing it (Plate xlviii. fig. 1) are all very strongly modified in different directions. One of them, as observed by Van der Hoeven, is separate from the rest except at the base. It is shorter than the others, and does not seem to be capable of being retracted, its sheath being very short: its free part, which is spathulate towards the extremity, lies under shelter of a wide fold extending backwards over it from the sheath of the tentacle which I have numbered 3. Tentacles 2, 3, and 4 have their sheaths united, but the tentacles themselves are quite separate. No. 2 is a thick, solid, muscular cylinder, or rather elongated, blunt cone, probably not capable of being extended to any great distance; the cavity of its sheath is very wide. No. 3 is elongated and laterally compressed, marked on its posterior and external surface with numerous transverse ridges. No. 4 presents the most remarkable modification; it is thick and cylindrical towards the base, becoming compressed towards the free end. The outer

surface (fig. 2) has the appearance of a minute honeycomb, owing to its being covered over with numerous rows of minute apertures, arranged with the greatest regularity.

On the free flap of the 3rd tentacle covering over the 1st, there is to be observed an oval dark patch, which to the naked eye appears minutely tuberculated. When this is examined under a lens (fig. 3) the tubercles are found to be minute elevations, each with a rounded aperture at its summit. Microscopic sections shew the thickened patch to contain numerous branching glands, the ducts of which open at the apertures mentioned. The specimens were not in good order for histological study; but the cells of the glands were found to be full of large rounded granules.

The remaining portion of the inner series (internal labial tentacles of Owen,* labial tentacular lobe of Keferstein†) is fully developed only in the female. It consists of a large flattened median lobe, situated posteriorly in immediate contact with the buccal mass. It is divided by a deep median notch into two parts, each of which bears fourteen tentacles. On the middle of its inner surface is an oval patch where the integument is raised up into numerous closely set ridges, which are in series with the tentacles, the most external ridges and the most internal tentacles being scarcely distinguishable from one another. This ridged body is referred to by Owen‡ as probably having an olfactory function, and a similar view is expressed by Ray Lankester.§ Van der Hoeven‖ dissents from this and expresses the belief that these folds are "only rudimentary digitations completing the circle of the internal labial processes."

It seems somewhat remarkable that a connection of some kind with the function of reproduction should not earlier have been suggested for the entire inner tentaculiferous lobe with its

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* Memoir on the Pearly Nautilus, 1832.

† Bronn's Thierreich, Malacozoa, III. Band, p. 1360.

‡ *Op. cit.*

§ Zool. Articles from the Encyclopædia Britannica, Mollusca, p. 137.

‖ Trans. Zool. Soc. iv.

tentacles and ridged organ. Its possession is quite as characteristic a feature of the female as the presence of the spadix is of the male. In the male its only representative is a bi-lobed folded body, termed by Van der Hoeven "cushion-shaped incised bodies."

Graham Kerr has apparently suggested such a connection for the ridged organ, as will appear from the following quotation from the abstract already referred to—"The curious laminated organ ventral to the buccal mass in the female, which had been believed to be olfactory, was pointed out as probably having some connection with reproduction — apparently being a glandular apparatus to which the spermatophore of the male becomes attached." That the organ has some such function seems to me extremely probable. In the Dibranchiate Cephalopods the hectocotylised arm is so long that it can readily be used as an intromittent organ for depositing the spermatophores in the mantle-cavity of the female. In the Nautilus, however, such intromission is impossible, and there must be some indirect mode of transmission of the spermatophores. It seems very probable that the whole inner part of the foot of the female is connected with this function, grasping the spadix and receiving the sperms from the cavities on its honey-combed tentacle. The presence in the wall of the mantle-cavity of the female of a pair of glands which appear to correspond to the nidamental glands of the Dibranchiata, would seem to render it probable that the ova must be fertilized in the mantle-cavity. The function of the laminated area, present only in the female, on the inner surface of the outer tentaculiferous lobe may, perhaps, be to form a brood-pouch for the developing ova. Such a function might be suggested for the inner lobe, were it not that the latter is in close contact with the buccal mass, and thus must be subject to frequent changes of position.

One of the six or eight female specimens examined by me presents a condition of the median inner tentaculiferous lobe, which may, perhaps, have a bearing on the functions of the part. In this specimen, which was a good-sized one and fully developed in

other respects, the lobe in question was represented by a rudiment (fig. 4), in which, however, all the parts of the perfected structure were distinctly and symmetrically represented. The condition of this single specimen does not afford sufficient grounds for attempting to make any deductions, but I direct attention to it here, as the examination of further material might establish this as a modification of regular occurrence, and, therefore, requiring to be taken into account in any attempt to explain the uses of the various tentaculiferous lobes.

EXPLANATION OF PLATE.

Fig. 1.—Spadix of mature *Nautilus pompilius* from the outer side (natural size) 1, 2, 3, 4 tentacles, *gld.*, glandular patch.

Fig. 2.—Portion of surface of tentacle 4, magnified.

Fig. 3.—Portion of the surface of glandular patch, magnified.

Fig. 4.—Inner tentaculiferous lobes of specimen referred to in the text.

ON THE OCCURRENCE OF DIATOMACEOUS EARTH AT THE WARRUMBUNGLE MOUNTAINS, N.S.W.

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